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## THREE ASPECTS OF THE THIRD MOLAR

**It is dedicated to Prof. MUDr. Jiří Mazánek, DrSc. to his life anniversary.**

*ABSTRACT: This study presents the essence of three already published articles with a common topic of the third molar. The first two parts of the study are taken as pilot studies of the development and agenesis of the third molar in the Czech population. In the data file of 1,700 panoramic radiographs of individuals ranging between 5–21 years (inclusive) of age, numerous characteristics were followed. From them, the time of dental follicle formation, dynamics of development and the incidence of third molars agenesis have been assessed. All data are differentiated considering sex and upper and lower jaw. Final results are specific for the Czech population, and complete the picture of adolescents' oral health.*

*Analyzing the results of the third molar development the authors get to the not yet described finding that in individuals with 1 to 3 third molar agenesis the development of founded third molars has been statistically significantly delayed in contrast to individuals with four third molars present.*

*Retardation is directly proportional to the number of non-founded third molars. This finding becomes a basis for developing a new method of age estimation in young individuals according to the state of their third molars development.*

*The basic principle on which this method is based forms the contents of the third part of the study. The developmental stage of the most developed third molar of an individual constitutes the determining factor for age estimation. Corresponding age is assessed according to a table. The table is made so that to allow to read the age of individuals with four third molars present and also the age of individuals with agenesis. Unlike methods used in adult age, this new method shows a high degree of accuracy.*

*KEY WORDS: Third molar development – Third molar agenesis – Third molar as an age indicator*

### INTRODUCTION

Since ancient ages the third molar has got a special position in the dentition. For its late formation and eruption, Pfaff had named it in 1756 (in Bishara, Andreasen 1983) "wisdom tooth". Despite more than questionable validity of this aphorism, the third molar has kept this denomination in specialist literature till today (wisdom tooth, Weisheitszahn, etc.). This shows an emotional approach to the third molar not just from lay people, but also among scientists.

As a carrier of numerous developmental anomalies the third molar has got the attribute "unpredictable". Robinson (Robinson, Vasir 1993) characterized it as follows: "The only thing we can predict about a third molar is its unpredictability." That was the reason why the third molar has not yet been used for age estimation.

Dentists consider the third molar to be a subject of mostly negative characteristics (Steinhardt *et al.* 1988). But if its qualities are considered as a source of phylogenetic and pathophysiological knowledge of dental development, its considerable importance cannot be denied (Vlček 1965, 1969). Variability of the developmental process in space and time makes from the third molar a desirable subject for genetic studies (Garn *et al.* 1962a, b, Hägg, Matsson 1985, Hölzl 1972, Marková, Vášková 1989, Schulze 1987). High percentage of agenesis incidence and its microsymptoms make from the third molar an important marker of specific dentition features of not just an individual, but also of whole ethnic groups (Hellmann 1936, Hintze, Wenzel 1990, Hübenthal 1989, Mappes *et al.* 1992, Mok, Ho 1996, Pedersen 1949, Rozkovcová *et al.* 1999, 2004a, Uzamis *et al.* 2000). For anthropologists and forensic medicine

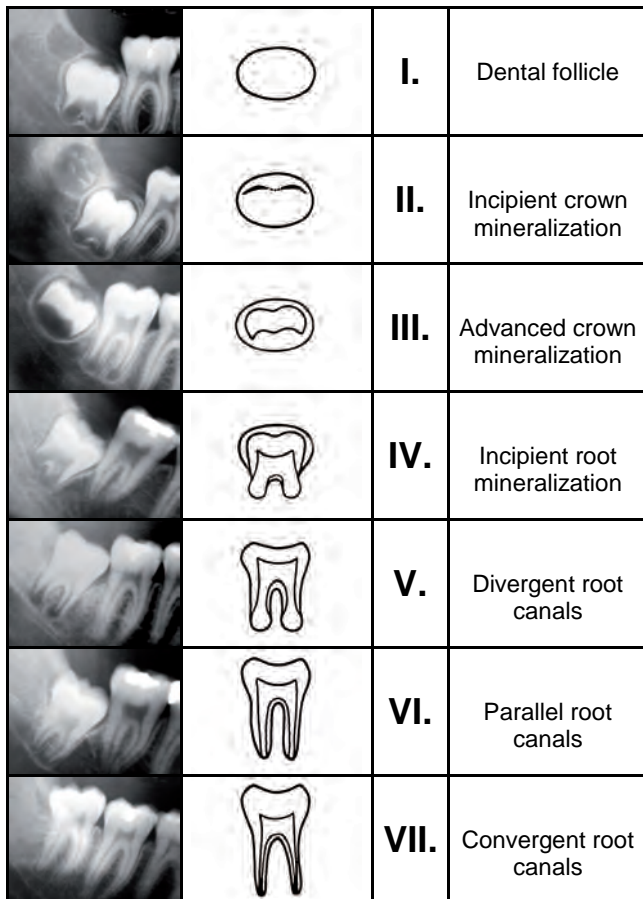


FIGURE 1. Scheme of developmental tooth stages.

specialists, the third molar means, as has hereby been proved, a most reliable marker of young individuals' age (Rozkovicová *et al.* 2005).

The frequency of third molars developmental anomalies is caused by their placement at the end of the dental lamina. It is the most vulnerable place from the genetic point of view (Hrdinová *et al.* 1980, Rozkovicová *et al.* 2004b, Schulze 1987). The extreme behaviour of the third molar during development, especially the extensive time range of its individual developmental features, is probably due to the peripeties undergone by the third molar during phylogenesis.

In Neandertal people the eruption sequence is M1, I1, I2, M2, (P1, C), P2, M3 (Vlček 1965). Starting from *Homo sapiens sapiens*, the eruption sequence is set as (M1, I1), I2, P1, (P2, C), M2, M3. The original eruption sequence of molars assumes that germs of these teeth were founded within a short time sequence. In recent people the developmental terms of the third molars are significantly delayed in comparison to permanent dentition (Rozkovicová *et al.* 1999, Vlček 1969).

This paper is a summary of results from three published works which are ideologically very close (Rozkovicová *et al.* 2004a, b, 2005). Its aim was to create an information

database on the third molar developmental process and anomalies in the Czech population. Obtained data are specific for the Czech population and belong to its basic characteristic features. The data are not transferable to other ethnics, as well as it is not possible to use data deduced from foreign populations as criteria for the assessing of Czech population.

During the study of material and analysis of results we have identified interesting, not yet published relationships between the third molar's development timing and its agenesis. Obtained results made it possible to elaborate a method of age estimation for young individuals on the basis of the third molar's development state (Rozkovicová *et al.* 2004a, b).

The life interval between 15 and 21 years of age is one of the periods with missing reliable age indicators. Evaluation on the basis of the optimal criterion – dental age – is out of the question, since the permanent dentition development, except the third molar, is already finished at that time (Demirjian *et al.* 1973, El-Nofely, Iscan 1989, Hägg, Mattsson 1985, Schour, Massler 1940, Smith 1991). The third molar that still continues its development, has so far been considered as unsuitable for this purpose because of a large range of its developmental time limits (Kullman *et al.* 1992, 1995, Mincer *et al.* 1993, Nortjé 1983, Thorsson, Hägg 1991). For example, in our file, the period of the third molar foundation ranges from 6 to 13 years. If we take in mind other biological age markers of an individual, as the skeletal age, sexual maturation, body mass, height etc., they are unusable or they show low reliability at that time period (Demisch, Hartmann 1956, Engström *et al.* 1983, Liliequist, Lundberg 1971, Pokorná 1983, Sajdok *et al.* 2001, Tanner *et al.* 2001).

Neither of the methods used for adult age estimation are suitable for age estimation of young individuals. Their small accuracy with estimation error  $\pm 5$ –10 years is not acceptable for an assessment of the short time period between 15–21 years. Moreover, estimation criteria of those methods, i.e. dentition ageing and wearing, are not sufficiently recognizable at the mentioned age (Gustafson 1950, Johanson 1971, Kilian 1975, Lamendin *et al.* 1992). In age estimation methods not based on dentition development processes, but on symptoms such as ageing and involution of dentition, it is better to talk about age markers (El-Nofely, Iscan 1989) rather than about dental age.

## MATERIALS AND METHODS

Study material consisted of a data file of 1,700 randomly chosen panoramic radiographs of patients from the Paediatric Department of the Stomatological Clinic, First Faculty of Medicine, Charles University in Prague. Age of probands was ranging between 5–21 years of age inclusive. Depending on age, 17 groups have been created. Each group consisted of 100 individuals (50 boys and 50 girls) in one year intervals. Individual groups included individuals

who passed the given age with  $\pm 6$  months of difference. Males and females were evaluated separately. The third molars were registered in every individual in all dentition quadrants. All statistical tests were done with 0.05 level of significance.

The time period of the third molar development from formation to root development termination was divided according to Komínek and Rozkocová (Komínek *et al.* 1975) into 7 stages (Figure 1). Evaluation of the third molar's developmental state was performed by two authors after cross-validation. The third molar development stages are very well identifiable on panoramic radiographs.

The study was divided in three separate parts: A. Development of the third molar; B. Agenesis of the third molar; and C. The third molar as an age indicator.

### A. Development of the third molar

In order to monitor the first appearance of the third molar germ in Czech children, we have first examined the group of

5-year-olds. Since we did not notice any single third molar germ in this group, our documentation deals with the third molar development in age groups between 6–21 years.

We have followed these markers: dental follicle formation, development termination, development dynamics, and relationship between the third molar development and dental age. All findings have been registered separately according to sex and upper and lower jaws.

### Dental follicle formation

The third molar is formed during the time period from 6–13 years of age. Later formation can be expected in hypodontia syndrome, ectodermal dysplasia and in systemic diseases connected with dental development delay.

The commonest age of the third molar dental follicle formation is 9 years in boys, and the period between 8–9 years in girls. The final time for the third molar dental follicle formation is 13 years of age inclusive in both sexes.

TABLE 1. Agenesis of 1–4 third molars in 450 boys and 450 girls at the age 13 to 21 years.

Age group	Sex	Individuals with 1–4 third molars agenesis		Number of non founded third molars
		Number of individuals	Per cent	
13	Boys	12	24.0	23
	Girls	14	28.0	24
	Boys and girls	26	26.0	47
14	Boys	13	26.0	27
	Girls	11	22.0	24
	Boys and girls	24	24.0	51
15	Boys	17	34.0	29
	Girls	10	20.0	21
	Boys and girls	27	27.0	50
16	Boys	14	28.0	26
	Girls	6	12.0	13
	Boys and girls	20	20.0	39
17	Boys	15	30.0	29
	Girls	8	16.0	20
	Boys and girls	23	23.0	49
18	Boys	11	22.0	19
	Girls	4	8.0	11
	Boys and girls	15	15.0	30
19	Boys	11	22.0	19
	Girls	9	18.0	16
	Boys and girls	20	20.0	35
20	Boys	6	12.0	8
	Girls	9	18.0	19
	Boys and girls	15	15.0	27
21	Boys	10	20.0	19
	Girls	8	16.0	16
	Boys and girls	18	18.0	35
13 to 21	Boys	109	24.2	199
	Girls	79	17.6	163
	Boys and girls	188	20.9	362

**Third molar development termination**

The lowest age of the third molar development termination in boys was 16 years in the upper jaw, 17 years in the lower jaw. In girls corresponding values are 17 and 18 years. The upper age limit for the third molar development termination was not possible to set, because at the age of 21 years, when the study ends, the development of all third molars was not finished yet. The most common age of the third

molar development termination was 20 years of age in both sexes (Table 1).

**Dynamics of the third molar development**

We have followed the third molar development on the basis of progress of individual development stages. This made it possible to assess intersexual differences and differences in dynamics of the third molar development in the upper and

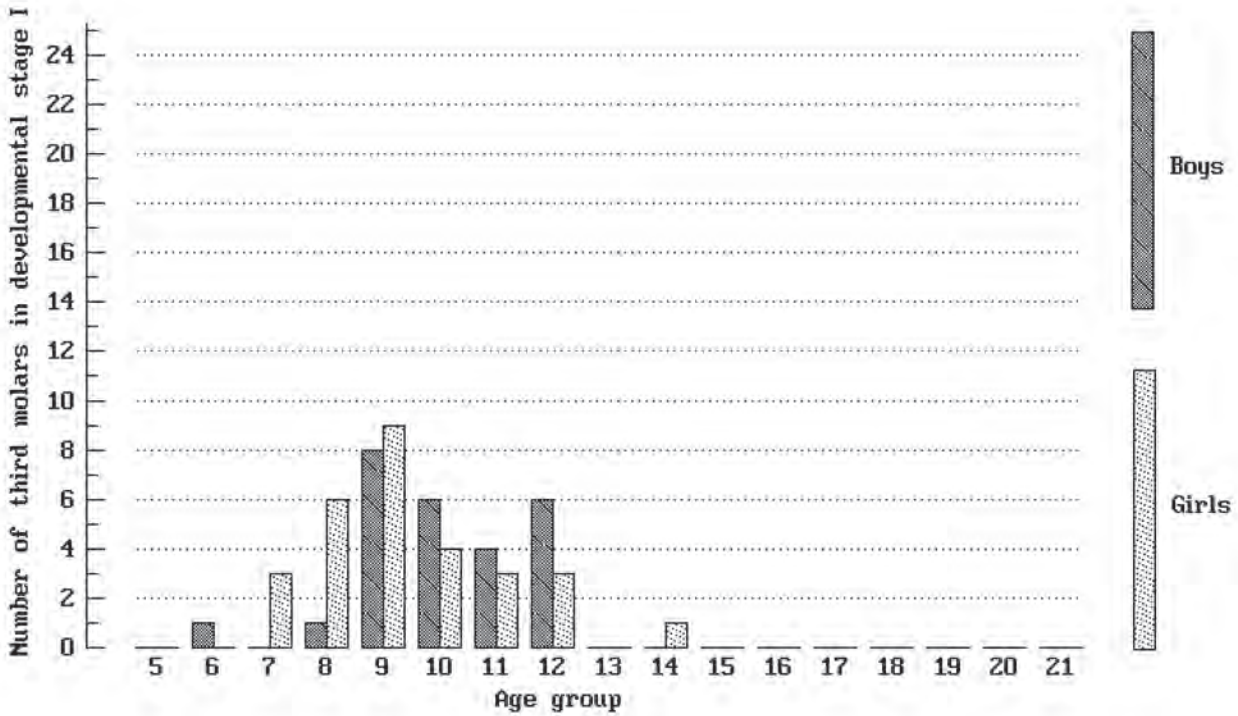


FIGURE 2. Number of third molars in stage I of development in different age groups in 1,700 individuals. Upper jaw.

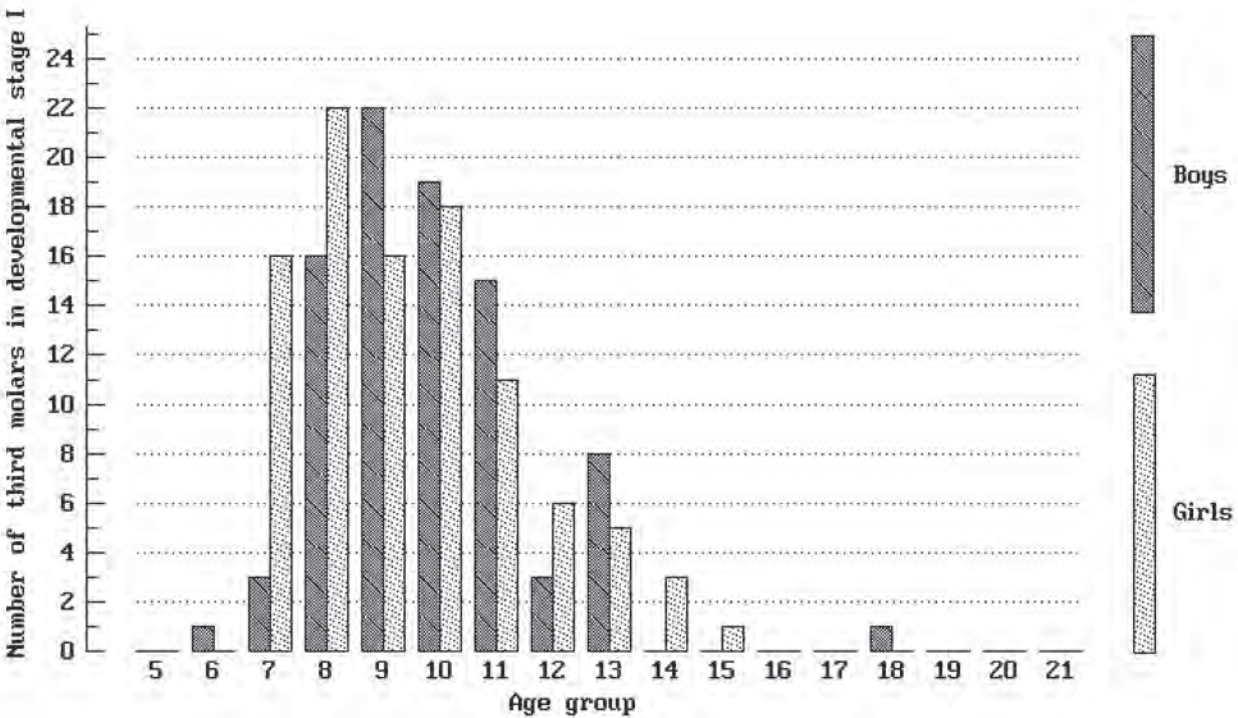


FIGURE 3. Number of third molars in stage I of development in different age groups in 1,700 individuals. Lower jaw.

lower jaws. We have also set the duration time of individual developmental stages.

The Ist stage is marked in both sexes with noticeable difference in the number of the third molar germs in the upper and lower jaws. During the whole period of dental follicle formation, i.e. from 6–13 years of age, we have noticed 26 third molar germs in the upper jaw of boys, and 29 germs in girls, while in the lower jaw we have noticed 88 germs in boys and 98 germs in girls (*Figures 2, 3*). This finding which corresponds with other authors' results can be partly explained by the very short duration of the Ist stage in the upper jaw (approximately ½ year), and partly with a poor visibility of the Ist stage in the structures of the upper jaw (Clow 1984).

The IInd stage is marked in both sexes – similarly to the previous stage – with a lower number of the third molars in the upper jaw, but the difference is less noticeable. The IInd stage duration is approximately 1 year.

In the IIIrd stage of development which lasts 3–4 years, the number of the third molar germs is getting even in both jaws.

The following IVth–VIth stages are marked with the third molars numerical predominance in the upper jaw in opposite to the lower one. The IVth stage lasts 1–2 years, the Vth stage approximately 2 years and the VIth stage 2–3 years. As already mentioned above, the duration of the VIIth stage was impossible to set.

In terms of time: Starting from the 10th year in boys and the 11th year in girls, the third molar development occurs more rapidly in the upper jaw, as compared with the lower jaw. This difference is statistically significant and represents approximately one development stage.

### ***Relation between the third molar development and dental age***

Dental age has been determined in 1,000 probands, aged from 7–16 years inclusive. At this age period the dentition provides enough supporting points for dental age estimation. Later it is not possible to use dentition development as an age indicator any more.

The comparison of dental age with the third molar development state in the same individual showed a considerable and statistically significant relation between both markers. That means that the third molar development is integrated into dentition development as its integral part. For clinical practice it is possible to conclude that the third molar can be considered as an age indicator, mainly in older age groups, when classical dental age is not valid (over 15 years of age).

### **B. Agenesis of third molars**

When following the third molar development process, it is impossible to leave out the problem of agenesis. Having traced the time of the third molar foundation, we found out that in the Czech population the latest formation time limit is the 13th year of age. This does not apply to individuals who suffer from hypodontia syndrome or

severe retardations of dentition development connected with systemic diseases.

The latest time limit for the third molar foundation is specific for each individual ethnic group and ranges between 12–16 years of age (Clow 1984, Gorgani *et al.* 1990, Hintze, Wenzel 1990, Hugoson, Kugelberg 1988, Logan, Kronfeld 1933, Richardson 1980, Schour, Massler 1940, Sonnabend 1966, Weise, Bruntsch 1965). This information can be more than any other modified by the selection and size of the group, methodology and the "human factor". A very important role is played here by the mode and quality of X-ray documentation. Reliable results can be expected only if panoramic radiographs are used.

The third molar agenesis incidence of is of high evidence value of the given ethnic group dentition character. Differences between races and populations range from practically zero values, found by Hellman in the skulls of Tasmanian people, through dozens of percent [Japanese 38% (Daito *et al.* 1992), Greenland inhabitants 30.5% (Pedersen 1949)] to almost 100% incidence of agenesis in some Mexican Indians tribes (Cohn 1956)].

In the Czech population the incidence of the third molar agenesis has not yet been registered. The aim of the study was to provide missing data for the use of stomatology, genetics, anthropology and forensic medicine specialists.

For agenesis of 1–4 third molars incidence estimation in the Czech population, 900 panoramic radiographs of individuals aged 13–21 years inclusive have been chosen from the basic file.

Besides global incidence of 1–4 third molars agenesis in both sexes, we were interested in differences of affection in individual dentition quadrants, the upper and lower jaws and right and left sides of the dentition. We have also followed the symmetry of agenesis incidence, very important from the clinical point of view. Finally we have set the agenesis incidence of one, whichever third molar and the number of congenitally missing third molars belonging to one proband.

On the basis of these calculations we set the percentage of intraindividual differences incidence. When evaluating the duration of the third molar development in individuals with agenesis, we have noticed an interesting and not yet described finding: in individuals with agenesis of 1 to 3 third molars the development of founded third molars is statistically significantly delayed in contrast to individuals with four third molars present (*Figure 4*).

In the present publication we have focused on the following: the incidence of third molars agenesis, intraindividual differences, and differences in third molars development in individuals with all third molars founded and in individuals with 1 to 3 third molars agenesis.

### ***Incidence of third molars agenesis***

Within the 900 individuals agenesis of 1 to 4 third molars occurred in 188 cases, i.e. in 20.9%: 109 boys (24.2%) and 79 girls (17.9%). This difference is statistically significant.

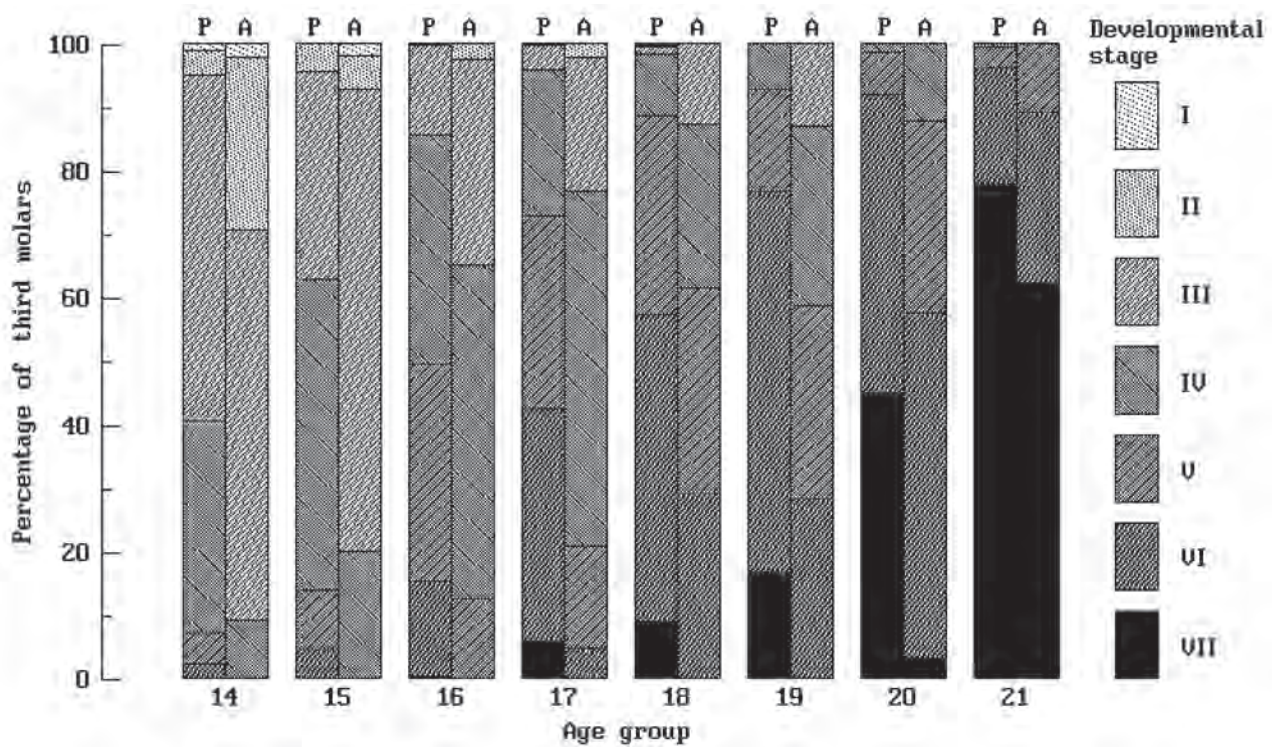


FIGURE 4. Frequency of individual developmental stages in dependence on chronological age, boys and girls and both jaws together. The subgroup marked "P" includes boys and girls with four third molars present, while subgroup marked "A" includes boys and girls with one to three third molars agenesis.

**Intraindividual differences**

Differences in the third molar development can be present interindividually, and also in the same individual. That means that the third molar development proceeds in each dentition quadrant of a same individual at a different time. These intraindividual differences together with the third molar agenesis form a clinical picture rich in combinations. The difference in individual molars development can represent as many as three stages (Figure 5).

Intraindividual differences can occur during the whole period of third molars development. Even in the last

monitored group of 21-year-old individuals, differences of 1–2 developmental stages were found in 17 boys (42.5%) and in 16 girls (38.1%). This phenomenon has played a fundamental role in the new method of age estimation in young individuals.

**Differences in third molars development in individuals with all third molars founded and in individuals with 1 to 3 third molars agenesis**

Comparing the development progress in the above mentioned groups, we have found out that in individuals with one to three third molars agenesis the development of



FIGURE 5. Intraindividual differences in third molar development. Panoramic radiograph of 16-year-old boy.

founded third molars is delayed. In the age group of 13–20 years inclusive this retardation is statistically significant. In the group of 21-year-old individuals this significance was not found (Figure 4).

This significant finding plays a key role, because it has allowed creating a method of young individuals' age estimation on the basis of the third molar development.

**C. The third molar as an age indicator**

The idea to use the third molar of young individuals' age estimation is not new at all. The period between 15–21 years of age lays on the dividing line of methods based on dentition development (dental age) and methods based on dentition ageing and wearing. None of the mentioned ways is reliable enough for the given period.

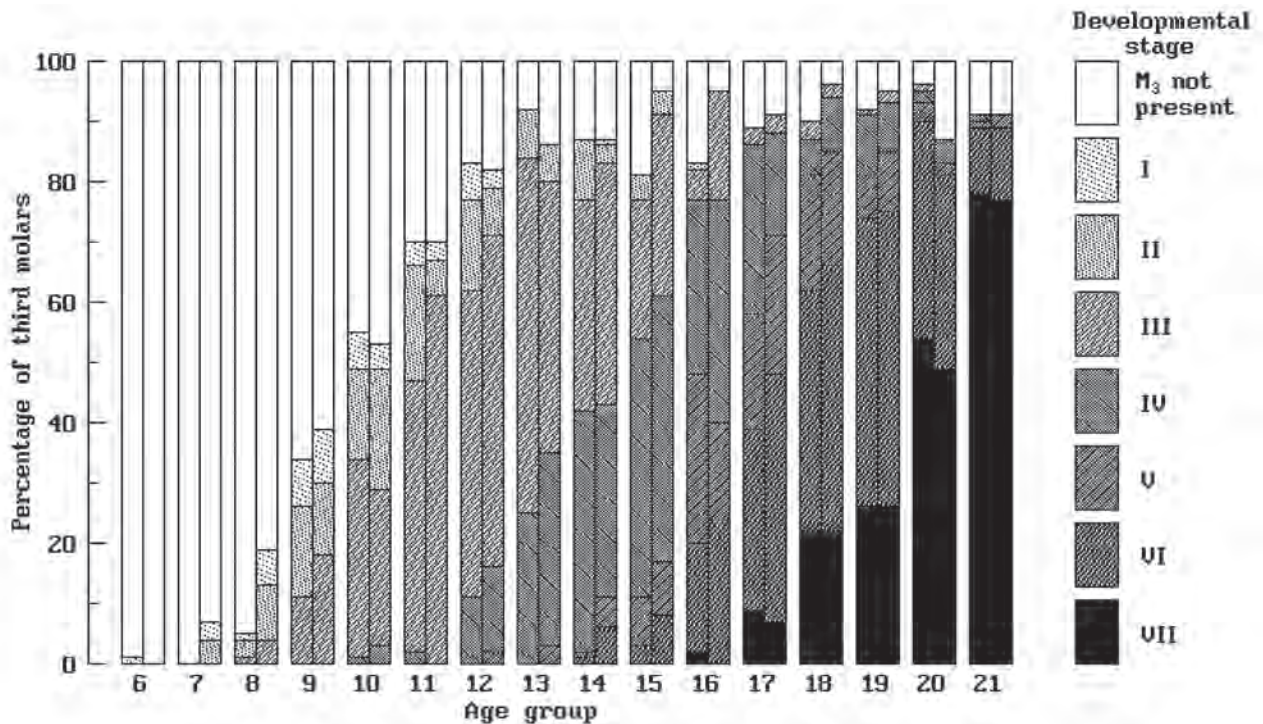


FIGURE 6. Frequency of individual developmental stages in dependence on chronological age, upper jaw. The left column in each pair shows the distribution in boys, and the right column in girls.

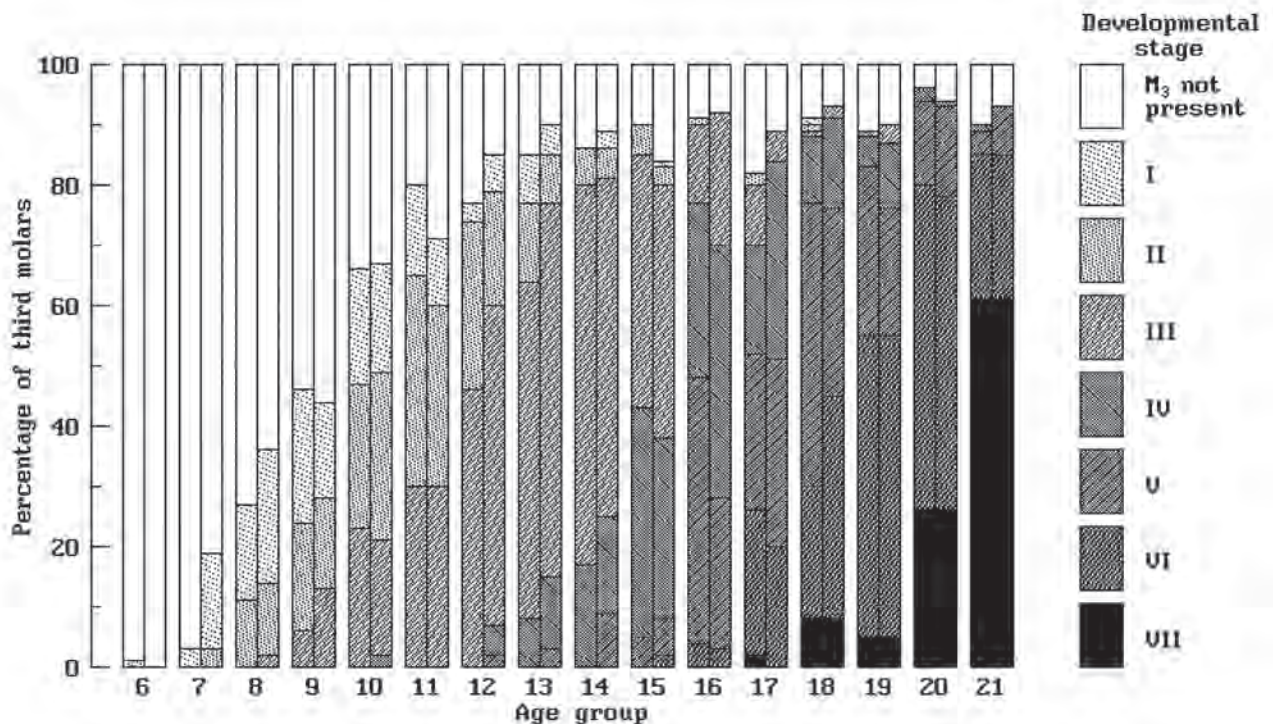


FIGURE 7. Frequency of individual developmental stages in dependence on chronological age, lower jaw. The left column in each pair shows the distribution in boys, and the right column in girls.

The third molar which develops at this time seems to be acceptable for this purpose. Works of many authors and our previous experience show that the third molar high instability of dentition development processes make it unsuitable for this purpose.

The huge time difference of its developmental terms is well visible in graphs, showing the incidence of individual developmental stages in age groups. In the time period from 15 to 21 years of age, each age group contains 4 to 6 developmental stages in different percentual representations. This fact seems to confirm that the third molar is not appropriate for age estimation (Figures 6, 7).

During the study of the third molar development and agenesis incidence in Czech population some observations were found out that led to a revision of hitherto accepted opinions, namely the not yet described finding of time difference in third molar development in individuals with four third molars founded and individuals with 1–3 third molars' agenesis. The incidence of 1–3 third molars' agenesis is as much as 20% in Czech population. This means that concerning the third molar the population is not homogeneous, but consists of two specifically different groups which have to be evaluated separately.

Another important finding was high, more than 50% incidence of intraindividual differences in the third molar development. As mentioned, this phenomenon lasts for the whole duration of the third molar development and differences can be of as many as three stages. The intraindividual differences in third molar development belong to of the hypodontia syndrome microsymptoms and can be related to a development retardation of founded third molars. This fact

means that determination of the final developmental stage of the third molar on the basis of stages average cannot be optimal and can lead to age underestimation.

Obtained knowledge led us to a new strategy in age calculation on the basis of the third molars development stage: 1. The followed file was divided in two groups: individuals with four third molars founded and individuals with one to three third molars agenesis. 2. Intraindividual differences were evaluated in two ways: on the basis of stage average of founded third molar (Method 1) and according to the stage of the most developed third molar (Method 2). 3. Intersexual differences were also followed in two ways: sexes were evaluated separately (Variant A) and sexes were not differentiated (Variant B). 4. Variations in dynamics of third molar development in the upper and lower jaws were evaluated differentially in all modifications of age calculation.

Age calculation was related to individual developmental stages of third molars as to the only source of information. The aim was to calculate the corresponding age for each developmental stage. In view of the fact that the third molar can be considered as an age indicator only after the other permanent teeth development has been completed, we have focused first of all on the time period from 15 to 21 years of age. At that time practically only the IVth to VIIth third molars' developmental stages can be found. The age of an individual with completed permanent dentition development and with the third molar in the third (or lower) stage, has to be 15 to 16 years. The terminal limit of 21 years for attainment the VIIth stage can be exceeded especially in hypodontia syndrome.

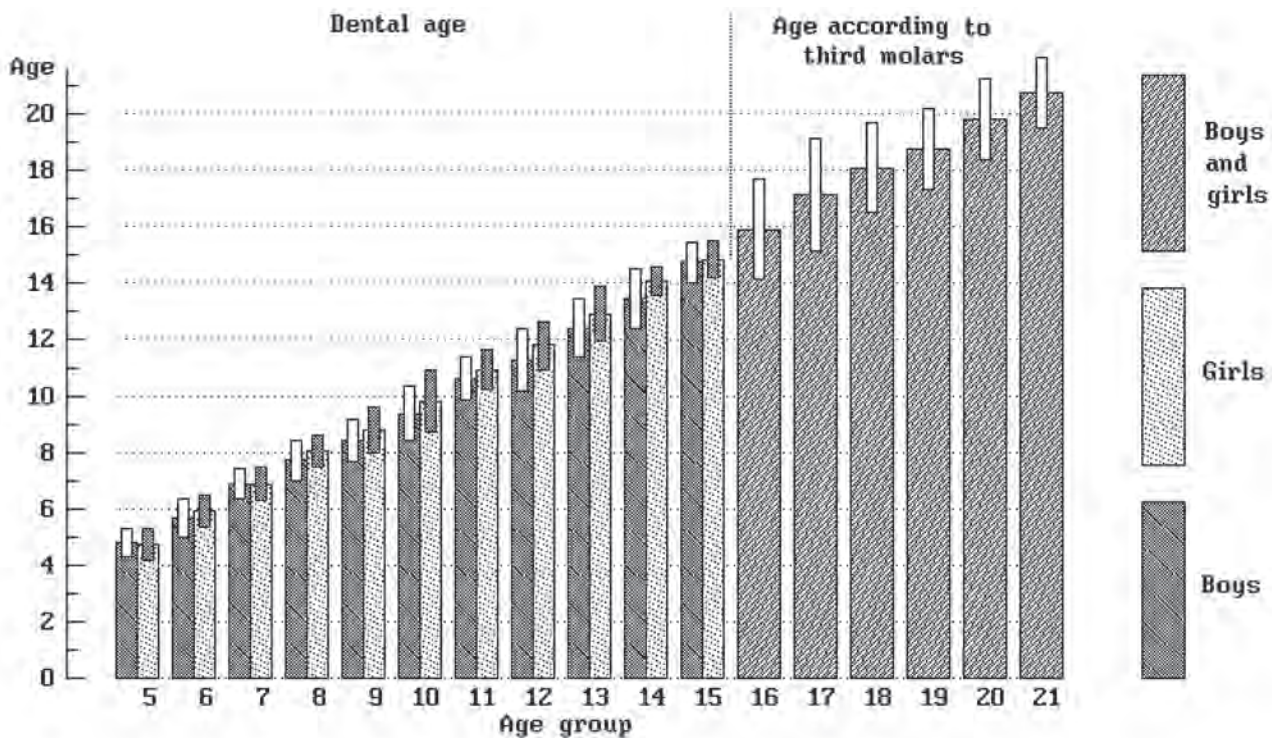


FIGURE 8. Dependence of chronological age estimation on age group. Rectangles over columns show the standard errors of the mean.



Age calculation corresponding to individual developmental stages of third molars has been verified by means of setting the average mean quadratic error of estimation. We have also followed mutual relationships between chronological age, dental age and age according to the third molar state of development. Results were evaluated in conformity with Methods 1 and 2, and also in conformity with Variants A and B, always taking into account the upper and lower jaws.

The complicated procedure during the calculation process in all listed ways has already been published. Therefore, the chapter "Third molar as an age indicator" shows the final results only, obtained by comparing the above mentioned methods.

**1. Division of file**

Calculations have proved a statistically significant difference in the time course of third molars development in individuals with four third molars founded, as compared with individuals with 1–3 third molars agenesis, and the key importance of division into two groups (Rozkovcová *et al.* 2004a, b).

*Age estimation – individuals with four third molars founded*

In this group the third molar development proceeds harmoniously without any considerable time differences. Average mean quadratic error of estimation is of 1.62 years. This estimation was made according to Method 2, Variant B, which has been selected as the optimal way for the final calculation. For comparison we have calculated the individual age estimation determined according to the dental age with average mean quadratic error of estimation 0.79 year. Errors of estimation in methods used for adults range  $\pm 5$ –10 years.

Linear relationship of chronological age, dental age and age determined according to third molars is shown in Figure 8.

*Age estimation – individuals with 1 to 3 third molars agenesis*

It has been evaluated according to Methods 1 and 2 and for a relatively small group according to Variant B only.

The age in this group has been estimated according to values obtained from individuals with four third molars founded. Mean quadratic deviations from chronological age and their average values for all age groups have been calculated separately for individuals with 1 to 3 third molars agenesis. Mean deviation in individuals with one third molar agenesis is  $-0.98$  year; in individuals with two third molars agenesis it is  $-1.89$  years, and in individuals with three third molars agenesis it is  $-3.28$  years. The deviation size is dependent on the number of non-founded third molars. Average mean quadratic deviations calculated in this way were later used for the correction of results in individuals with 1 to 3 third molars agenesis. Mean error of estimation of results corrected in this way is not bigger than the error of estimation in individuals with four third molars founded.

**2. Age estimation – intraindividual differences in third molar development**

In comparing both Methods (1 and 2) it has been found out that there is no statistically significant difference between the results. Method 2, which evaluates the age on the basis of the most developed third molar, is much simpler and faster than Method 1. That is why we have preferred Method 2 for the final calculation.

**3. Age estimation according to sex**

Neither in the group with four third molars founded, nor in the group with 1 to 3 third molars agenesis, no significant intersexual differences were found in the third molars development and that means also no significant differences in age estimation. When the mean error of age estimation for Variants A and B is compared, the results are practically the same. Therefore we prefer Variant B for age estimation.

**4. Age and dynamics of third molars development in the upper and lower jaws**

In both sexes and using both Methods 1 and 2, there is a tendency to later third molar development in the lower jaw in comparison with the upper jaw. At the age of 15 to 21 years the third molar's development in the lower jaw is delayed by approximately one developmental stage

TABLE 2. Chronological age determination on the basis of developmental stage of third molars.

Developmental stage	All four third molars present	Not present		
		One third molar	Two third molars	Three third molars
<b>Corresponding age</b>				
<b>Upper jaw</b>				
IV	14.68	15.68	16.68	17.68
V	16.26	17.26	18.26	19.26
VI	18.16	19.16	20.16	21.16
<b>Lower jaw</b>				
IV	15.49	16.49	17.49	18.49
V	17.18	18.18	19.18	20.18
VI	19.28	20.28	21.28	22.28

TABLE 3. Age corresponding to developmental stages I–VII of third molars in boys with all four third molars and that with 1 to 3 third molars only.

Developmental stage	All four molars present				One to three molars not present			
	Chronological age		Number of individuals*	Maximal	Chronological age		Number of individuals*	Maximal
	Mean	SD			Minimal	Mean		
	Boys, upper jaw							
I	0	–	<13	<13	0	–	<13	<13
II	7	<13.71	0.76	<13	7	1.07	<13	16
III	50	<13.82	1.04	<13	15	1.28	<13	20
IV	72	<15.03	1.64	<13	18	1.82	<13	20
V	38	16.76	1.40	14	6	0.75	17	20
VI	99	18.28	1.37	14	11	1.42	17	21
VII	77	20.10	1.18	16	3	0.00	20	21
	Boys, lower jaw							
I	5	<14.00	2.24	<13	0	–	<13	<13
II	10	<13.90	1.60	<13	5	1.14	<13	17
III	73	<14.11	1.11	<13	21	1.60	<13	19
IV	51	<15.51	1.63	<13	13	1.24	15	20
V	75	17.55	1.44	15	11	1.45	16	21
VI	89	19.08	1.32	16	8	1.20	18	21
VII	41	20.59	0.59	19	2	0.00	21	21

\* number of individuals with a third molar at the respective developmental stage

TABLE 4. Age corresponding to developmental stages I–VII of third molars in girls with all four third molars and that with 1 to 3 third molars only.

Developmental stage	All four molars present				One to three molars not present			
	Chronological age		Number of individuals*	Maximal	Chronological age		Number of individuals*	Maximal
	Mean	SD			Minimal	Mean		
	Girls, upper jaw							
I	1	<14.00	–	<13	0	–	<13	<13
II	4	<14.25	0.96	<13	3	0.58	<13	14
III	51	<14.20	1.17	<13	19	1.64	<13	19
IV	85	<15.18	1.69	<13	7	1.68	14	20
V	42	<16.69	1.65	<13	4	1.26	18	21
VI	105	18.03	1.67	14	5	0.84	19	21
VII	88	19.91	1.17	17	2	0.00	21	21
	Girls, lower jaw							
I	2	13.50	0.71	<13	3	0.58	<13	15
II	5	14.00	1.00	<13	3	0.58	<13	14
III	83	14.29	1.17	<13	15	2.08	<13	19
IV	77	15.95	1.58	<13	2	2.12	16	19
V	69	17.36	1.85	<13	5	1.52	17	21
VI	88	19.00	1.31	15	5	0.71	19	21
VII	48	20.35	0.93	18	3	0.00	21	21

\* number of individuals with a third molar at the respective developmental stage

in comparison to the third molars in the upper jaw. This difference is statistically significant.

The final results according to Method 2, Variant B with differentiation for the upper and lower jaws are shown in the universal *Table 2*. The table allows to read directly the age corresponding to the third molars developmental stages in both individuals with four third molars founded as well as in individuals with 1 to 3 third molars agenesis. For the latter individuals the results have been corrected according to the number of non-founded third molars in order to agree with their real age.

*Tables 3 and 4* complete data about the relation between age and developmental stages of third molars in boys and girls.

## DISCUSSION

The first part of the present study concerning the third molar development is one of a few works devoted to monographic processing of that theme. This part is also an example how strictly theoretical knowledge finds its use in practice. In this case, it was not only the development of an age estimation method according to third molars, but also indications setting so called "third molars purpose-directed extractions" as a prophylaxis of third molars eruption complications and impaction.

In the second part concerning the third molar agenesis there was a quite surprising finding of statistically significant prevalence of males in the incidence of 1 to 4 third molars agenesis in opposite to females. Mostly females' predominance of the third molar agenesis is listed, the same as in hypodontia syndrome. In the available literature just three authors mention significant third molar prevalence in males (Levesque *et al.* 1981, Lynham 1989, Shah, Boyd 1979, Thompson *et al.* 1975).

In the studied file there was a predominance of boys comparing with girls in all age groups, with the exception of the 13th and 20th groups, in which the differences were not significant. Taking into account the size of the file (1,700 individuals), this finding indicates that the result is not accidental. In the given context, we mention that Marková and Taichmanová (1985), monitoring the hypodontia incidence in the Czech population, did not find intersexual differences.

Age estimation of young individuals established on the basis of the third molar's state of development, which forms the contents of the third part of the study, is basically very easy. However, in practice there can appear some circumstances which are out of the possibilities of the method or which can make the whole process difficult.

As we have mentioned, the described method is based on the presumption that there is no statistically significant difference between chronological age and age based on the third molar development. This premise is valid for physiological situations, when time differences in the third molar development range in the mean error of estimation.

But in practice we can face pathological conditions, accompanied with deviations outranging standard time limits. Mostly, it is a matter of a severe retardation of the whole permanent dentition development, on the basis of which an individual can be classified into a lower age group. Acceleration of development is much rarer (Pinkham 1994, Poulsen, Koch 2002, Rozkocová *et al.* 2005, Schulze 1987).

This possibility has to be considered each time when there is a facial and cranial skeleton affected with morphological anomalies, with manifestations of skeleton systemic diseases and so on. It is necessary to pay attention also to syndromes accompanied with severe hypodontia. In these cases stomatological findings must be confronted with skeletal ones and possibly also with findings on soft tissues. In such cases chronological age can be estimated after a consultation with relevant specialists. Described pathological conditions are not common in everyday practice, increased frequency can be met in isolated cases.

Age estimation accuracy can be lowered by incomplete conclusive material – absence of relevant parts of dentition. For approximate orientation at least one third molar and one second permanent molar are needed. These teeth do not have to belong to the same dentition quadrant. Besides the third molar, the final marker of dental age is the second molar which terminates the permanent dentition development. That means that upon completion of the second molar development, the third molar can be taken into account as an age indicator.

Non identifiable sex does not mean a serious problem. As we have ascertained, in the Czech population there are no significant intersexual differences in the third molar development process.

In recent remains there is a cardinal question, if the reason of the third molars absence is due to agenesis or extraction. The way of chronological age calculation depends on this assessment. Third molars' extractions because of orthodontical reasons are nowadays very common.

During extraalveolar period of the third molar's development, extractions for eruption complications should be considered. It has to be noted that we are treading here on the eggshells of hypothesis. However, there exist certain guidelines that can improve the estimation accuracy and so make the conclusions more reliable.

The missing of all third molars can be caused by agenesis or orthodontic extractions as well. In such cases the etiology is not relevant – there is nothing to evaluate.

Every case needs careful analysis and individual approach. The absence of third molars in some quadrants of the dentition whose development is otherwise finished, together with the finding of the IIIrd or IVth developmental stage of present third molars means almost conclusively agenesis of non-present molars.

In hypodontia syndrome as well as in hypodontia syndrome microsymptoms (i.e. anomalies of size, shape and position of several teeth) in cases of third molar missing we rather support the diagnosis of agenesis.

The third molar postextractional state generally corresponds to teeth's crowding. The third molars extractions because of eruption complications at adolescent age are encountered mostly in the lower jaw, where the diagnosis can be proved with space deficiency in the third molar region. In these cases one can rely on the third molars state of development in the upper jaw. It is always necessary to look for possible changes in osseous structures in the region of the healed extraction wound.

## CONCLUSION

From the multilayered issue of the third molar, the authors have chosen three topics which are connected to each other: third molar development, third molar agenesis and third molar as an age indicator in young individuals.

The former two parts give basic information on the third molar as a subject sui generis, enabling stomatologists, geneticists, anthropologists and forensic medicine specialists to draw experience from it. The data are specific for the Czech population; they were not available till now and they are essential for comparative studies of the third molar in different ethnics.

The third part – the third molar as an age indicator – is a classical illustration of theoretical knowledge application in practice. The new method of chronological age determination is based on the finding that in individuals with agenesis of 1 to 3 third molars the development of founded third molars is statistically significantly delayed in comparison with individuals with all third molars founded. Considering the methods used for adults, the new way is characterized by considerable accuracy and reliability.

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